

CLAIMS

We claim:

1. An ultraviolet disinfection (UV) system for treating waste-containing fluid, the system comprising at least one light source positioned within a housing and connected to a power source for producing a UV light output from the housing, the system including at least one optical component positioned between the at least one light source and the UV light output from the housing, thereby producing a focused, controllable UV light output that has at least one UV dose zone for providing effective sterilization of microorganisms within the fluid.

2. The UV system according to claim 1, wherein the at least one UV light source is one lamp.

3. The UV system according to claim 1, wherein the at least one UV light source is a UV lamp.

4. The UV system according to claim 3, wherein the at least one UV light source is a spectral calibration lamp.

5. The UV system according to claim 3, wherein the at least one UV light source is an electrodeless lamp.

6. The UV system according to claim 3, wherein the at least one UV light source is a mercury halide lamp.

7. The UV system according to claim 1, wherein the at least one UV light source is a light pump device.

8. The UV system according to claim 7, wherein the output from the at least one UV light source is distributed by fiber optic transmission lines.

1 *Sub A 3* 9. The UV system according to claim 7 wherein the fiber optic transmission lines
 2 having a first end connected to the housing output such that the UV light output from the
 3 housing passes through the fiber optic transmission lines and exiting from a second end
 4 such that the UV light output exiting the fiber optic transmission lines is projected into
 5 the water.

6 10. The UV system according to claim 8, wherein the fiberoptic lines include
 7 acrylic fibers.

8 11. The UV system according to claim 8, wherein the fiberoptic lines include
 9 glass fibers.

10 12. The UV system according to claim 8, wherein the fiberoptic lines include
 11 liquid core fibers.

12 13. The UV system according to claim 8, wherein the fiberoptic lines include
 13 hollow core fibers.

14 14. The UV system according to claim 8, wherein the fiberoptic lines include
 15 core-sheath fibers.

16 15. The UV system according to claim 8, wherein at least one fluid-containing
 17 device is connected to the light pump device via fiberoptic transmission lines.

18 16. The UV system according to claim 1, further including a non-fouling lamp
 19 housing thereby eliminating cleaning of the lamp housing to ensure consistent UV
 20 disinfection of the fluid.

21 17. The UV system according to claim 1, wherein the light housing is affixed to a
 22 reservoir and the UV light output disinfects a substantially non-flowing water supply
 23 contained within the reservoir.

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1 18. The UV system according to claim 17, wherein the system has a non-vertical
2 riser configuration.

3 19. The UV system according to claim 1, wherein the lamp housing is affixed to a
4 reservoir with flowing water contained therein.

5 *Sub A* 20. The UV system according to claim 2, further including a vertical riser
6 configuration (VRC) wherein the water is moved at a predetermined rate toward the UV
7 light output thereby producing an increasing UV dose within the water as it approaches
8 the light output.

9 *Sub A* 21. The UV system according to claim 20, wherein the interface zone further
10 includes at least one additive that influence characteristics of the fluid as the fluid passes
11 through the interface zone and over the surface zone.

12 22. The UV system according to claim 21, wherein the at least one additive is
13 selected from the group consisting of TiO₂, WO₂, ZnO, ZnS, SnO₂, and PtTiO₂ and the
14 like.

15 23. The UV system according to claim 20, wherein the vertical riser configuration
16 system is portable.

17 24. The UV system according to claim 20, wherein the vertical riser configuration
18 system is scalable to applications.

19 25. The UV system according to claim 20, wherein the system is adaptable to be
20 removably connected to a piping system for carrying water to an end user output, such
21 that a multiplicity of systems may be positioned to function at a corresponding
22 multiplicity of end user outputs to provide disinfected, purified water in many locations at
23 once.

1 26. The UV system according to claim 1, wherein the at least one optical
2 component is selected from the group consisting of reflectors, shutters, lenses, splitters,
3 focalizers, mirrors, rigid and flexible light guides, homogenizer, mixing rods, manifolds
4 and other couplers, filters, gratings, diffractors, color wheels and fiber optic transmission
5 lines.

6 27. The UV system according to claim 1, wherein at least one optical component
7 is an off-axis optical component.

8 28. The UV system according to claim 1, wherein at least one optical component
9 is a gradient component.

10 29. The UV system according to claim 1, wherein at least one optical component
11 is UV transmissive.

12 30. The UV system according to claim 1, wherein at least one optical component
13 is UV reflective.

14 *Sub A5* 31. The UV system according to claim 1 wherein the at least one optical
15 component includes fiber optic transmission lines having a first end connected to the
16 housing output such that the UV light output from the housing passes through the fiber
17 optic transmission lines and exiting from a second end such that the UV light output
18 exiting the fiber optic transmission lines is projected into the water. *AS 12*

19 32. The UV system according to claim 26, wherein the at least one optical
20 component is a lens for focusing light from the light source through an output point in the
21 housing and into the water for disinfection thereof. *AS 12*

22 33. The UV system according to claim 32, wherein the lens is a parabolic lens.

34. The UV system according to claim 1, wherein the at least one UV dose zone includes a water-air interface dose zone and a variable intra-fluid dose zone.

Sub A 635. ~~The UV system according to claim 1, wherein the at least one UV light source is positioned outside the water to be treated thereby providing effective sterilization of microorganisms within the water.~~

36. An ultraviolet disinfection (UV) system for treating waste-containing fluid, the system comprising at least one light source positioned outside the fluid to be treated and positioned within a housing and connected to a power source for producing a UV light output from the housing, the system including at least one optical component positioned between the at least one light source and the UV light output from the housing, thereby producing a focused, controllable UV light output that has at least one UV dose zone for providing effective sterilization of microorganisms within the fluid.

37. The UV system according to claim 36, wherein the at least one UV light source is a single UV lamp.

38. The UV system according to claim 36, wherein the at least one UV light source is a spectral calibration lamp.

39. The UV system according to claim 36, wherein the at least one UV light source is an electrodeless lamp.

40. The UV system according to claim 36, wherein the at least one UV light source is a mercury halide lamp.

41. The UV system according to claim 36, wherein the at least one UV light source is a light pump device.

1 42. The UV system according to claim 36, wherein the at least one UV light
2 source is a pulsed lamp device.

3 43. The UV system according to claim 36, further including a non-fouling lamp
4 housing thereby eliminating cleaning of the lamp housing to ensure consistent UV
5 disinfection of the fluid.

6 44. The UV system according to claim 36, wherein the light housing is affixed to
7 a reservoir and the UV light output disinfects a substantially non-flowing water supply
8 contained within the reservoir.

9 45. The UV system according to claim 44, wherein the system has a non-vertical
10 riser configuration.

11 46. The UV system according to claim 36, wherein the lamp housing is affixed to
12 a reservoir with flowing water contained therein.

13 47. The UV system according to claim 36, further including a vertical riser
14 configuration (VRC) wherein the water is moved at a predetermined rate toward the UV
15 light output thereby producing an increasing UV dose within the water as it approaches
16 the light output.

17 48. The UV system according to claim 36, wherein the interface zone further
18 includes at least one additive that influence characteristics of the fluid as the fluid passes
19 through the interface zone and over the surface zone.

20 49. The UV system according to claim 48, wherein the at least one additive is
21 selected from the group consisting of TiO_2 , WO_2 , ZnO , ZnS , SnO_2 , and PtTiO_2 and the
22 like.

1 50. The UV system according to claim 47, wherein the vertical riser configuration
2 system is scalable to applications.

3 ~~50~~⁵⁰ 51. The UV system according to claim 46, wherein the system is adaptable to be
4 removably connected to a piping system for carrying water to an end user output, such
5 that a multiplicity of systems may be positioned to function at a corresponding
6 multiplicity of end user outputs to provide disinfected, purified water in many locations at
7 once.

8 ~~51~~⁵¹ 52. The UV system according to claim 36, wherein the at least one optical
9 component is selected from the group consisting of reflectors, shutters, lenses, splitters,
10 focalizers, mirrors, rigid and flexible light guides, homogenizer, mixing rods, manifolds
11 and other couplers, filters, gratings, diffractors, color wheels and fiber optic transmission
12 lines.

13 ~~52~~⁵² 53. The UV system according to claim 36, wherein at least one optical component
14 is UV transmissive.

15 ~~53~~⁵³ 54. The UV system according to claim 36, wherein at least one optical component
16 is UV reflective.

17 ~~54~~⁵⁴ 55. The UV system according to claim 36, wherein the at least one optical
18 component includes fiber optic transmission lines having a first end connected to the
19 housing output such that the UV light output from the housing passes through the fiber
20 optic transmission lines and exiting from a second end such that the UV light output
21 exiting the fiber optic transmission lines is projected into the water.

22 ~~55~~⁵⁵ 56. The UV system according to claim ~~55~~⁵⁴, wherein the fiberoptic lines include
23 acrylic fibers.

1 ~~56. 51~~⁵². The UV system according to claim ~~55~~⁵⁶, wherein the fiberoptic lines include
2 glass fibers.

3 ~~57, 58~~. The UV system according to claim ~~58~~, wherein the fiberoptic lines include
4 liquid core fibers.

5 ~~58~~⁵⁹. The UV system according to claim ~~58~~⁵⁹, wherein the fiberoptic lines include
6 hollow core fibers.

7 ~~59.60~~. The UV system according to claim ~~55~~, wherein the fiberoptic lines include
8 core-sheath fibers.

9 *Sub A 961.* The UV system according to claim 52, wherein the at least one optical
10 component is a lens for focusing light from the light source through an output point in the
11 housing and into the water for disinfection thereof.

12 ~~61. 62.~~ The UV system according to claim ~~61~~, wherein the lens is a parabolic lens.

13 ~~62-63.~~ The UV system according to claim 36, wherein the at least one UV dose zone
14 includes a water-air interface dose zone and a variable intra-fluid dose zone.

15 64. A method for purifying waste-containing fluids comprising the steps of:
16 *Sub A 10* providing the fluid to be treated in a reservoir;

17 exposing the reservoir and fluid to a UV system including at least one light source
18 positioned within a housing and connected to a power source for producing a UV light
19 output from the housing, the system including at least one optical component positioned
20 between the at least one light source and the UV light output from the housing;

21 producing a focused, controllable UV light output that has at least one UV dose
22 zone for providing effective sterilization of microorganisms within the water.

submerged light source.

~~66.65~~. A method for providing ultraviolet disinfection (UV) of waste-containing

fluids, the method comprising the steps of

providing a UV disinfection system comprising at least one UV light

source coupled with at least one UV-transmissive optical component outside a fluid to be

treated and at least one interface zone positioned between the at least one UV light source

and the fluid to be treated, the at least one UV light source designed, configured, and

connected to produce UV light creating at least one UV dose zone outside the fluid;

presenting a surface zone on the at least one interface zone, wherein the surface

zone has a UV dose zone associated therewith for disinfecting the fluid to be treated;

introducing a pre-treated fluid into the system, the fluid passing through at least

one UV dose zone within the fluid and passing through the at least one interface zone and

surface zone UV dose zone;

disinfecting the fluid via exposure to the UV light in the UV dose zones;

dispensing the disinfected fluid outside the system.

67.66. The method according to claim-66, further including the step of forcing

water via a hydraulic system through a vertical riser configuration of the system.

68.67. The method according to claim 66, further including the step of modifying

the fluid characteristics via at least one additive on the interface zone causing a reaction

in the fluid.

- 1 ~~68~~⁶⁵. The method according to claim ~~66~~⁶⁵, further including the step of
- 2 introducing turbulence in the fluid as the fluid passes throughout the system, thereby
- 3 increasing the exposure to UV light, disinfection, and catalytic chemical reactions.
- 4 ~~70~~⁶⁵. The method according to claim ~~66~~⁶⁵, further including the step of
- 5 introducing a catalyst at the interface zone.
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